

Use of Constructed Wetland cum Microbial Fuel Cell for Urban Waste Water Treatment & Nutrients Recovery: A Review

Akshay Tiwari^{1*}, Ambar Tiwari², Arya Devansh³, Deepak Kumar⁴, Prof. Mayank Nigam⁵

^{1,2,3,4}Dept. of Civil Engineering ABES Institute of Technology, Ghaziabad

⁵Asst. Professor, Dept. of Civil Engineering, ABES Institute of Technology, Ghaziabad, India

Abstract - In India, almost 80% of water supply flows back into the ecosystem as wastewater which is critical environmental and health hazard if not treated properly but its proper management could help the water managers in meeting the city's water demand. Currently, India has the capacity to treat approximately 37% of its wastewater, or 22,963 million litre per day (MLD), against a daily sewage generation of approximately 61,754 MLD according to the 2015 report of the Central Pollution Control Board. Moreover, most sewage treatment plants do not function at maximum capacity and do not conform to the standards prescribed. Urban waste water treatment is milestone for every municipal corporation and to target above said gap area its needed to apply technologies from various field of engineering such as environmental engineering, civil engineering, biotechnology, electrical engineering and mechanical engineering. The previously discussed problem can be solved using a hybrid technological solution resulting from perfect synchronization of constructed wetland technology, microbial fuel cell technology and non-conventional energy resource to power the resulting innovation. The proposed solution is efficient enough to treat urban waste water physically, chemically and biologically by perfect combination set of technologies which are specifically selected and implemented to target specific fraction of pollutant/aggregates/biological content mixed in the waste water. Implementation of our proposed technology will be as simple as digging a well and be implemented by using less manpower and financial resources. One such proposed waste water treatment plant will have capacity to treat waste water ranging from 1000L-100000L/day and generation of employment, reduction of pollution and development of parallel economy of nutrient recovery industry from waste water could also be possible.

Key Words: Biotechnology, Ecosystem, Environment Engineering, Pollution, Constructed Wetland, Microbial Fuel Cell, Wastewater, Wastewater Treatment etc.

1.INTRODUCTION

India is one of the rapidly progressing economy of the world and leading in the race of all developing countries to become completely self-sufficient economy like U.S.A. U.K. and Russia. But despite of making leading progress in aerospace technology and human resource, it is a way behind in terms of waste water treatment and water conservation because of unavailability of indigenous effective technology for waste water treatment and nutrient recovery from waste water.

Presently installed waste water treatment plant in Indian cities to treat urban waste water are struggling towards achieving complete waste water treatment generated from the specific city but they are inefficient in terms of indigenous effective treatment such as decrease in BOD/COD of waste water along with removal of chemical pollutants.

Apart from this the biggest problem faced by conventional waste water treatment technologies are ever increasing urban population along with floating population during occasions which resulting into sudden increment in the amount of waste water. This resulting into the failure of previously installed waste water treatment plant.

There are many plants in India which are facing similar problems which resulted into inefficiency of the waste water treatment system.

To bridge above identified gap areas, it is required to have an Indigenously developed eco-friendly technology to address waste water treatment problem in urban areas. The proposed research work targeted or the waste water management system overhaul in India in general and the whole world in particular. The herewith disclosed technology is combination of two well-known scientifically approved environmentally safe carbon neutral technologies which are microbial fuel cell and constructed wetland powered by non-conventional energy resources like solar photovoltaic and wind energy.

2. Materials

Electrodes- Used in anode and cathode chamber. The material used in electrode directly affects the efficiency of MFC. The material which is used in MFC generally includes carbonaceous material in combination of other materials.

Proton exchange membrane- it is a core component that directly affects the electrochemical process in MFC. It is a component which enables only hydrogen ions or protons (H^+) to pass through it.

Substrate- it is the organic matter used as source of energy for microorganism i.e. waste water.

Microbes- these are the bacteria which are used for MFC applications.

Acrylics- a material used for microbial fuel cell structure.

Minimum Density Fiber Board- for development of base of fuel cell.

Photovoltaic Crystals and Batteries- for providing power to the project.

For construction of wetlands there include natural components such as soil, sand, gravel, rock, and organic materials.

Apart from these some hardware tools and specified electronic components are also required.

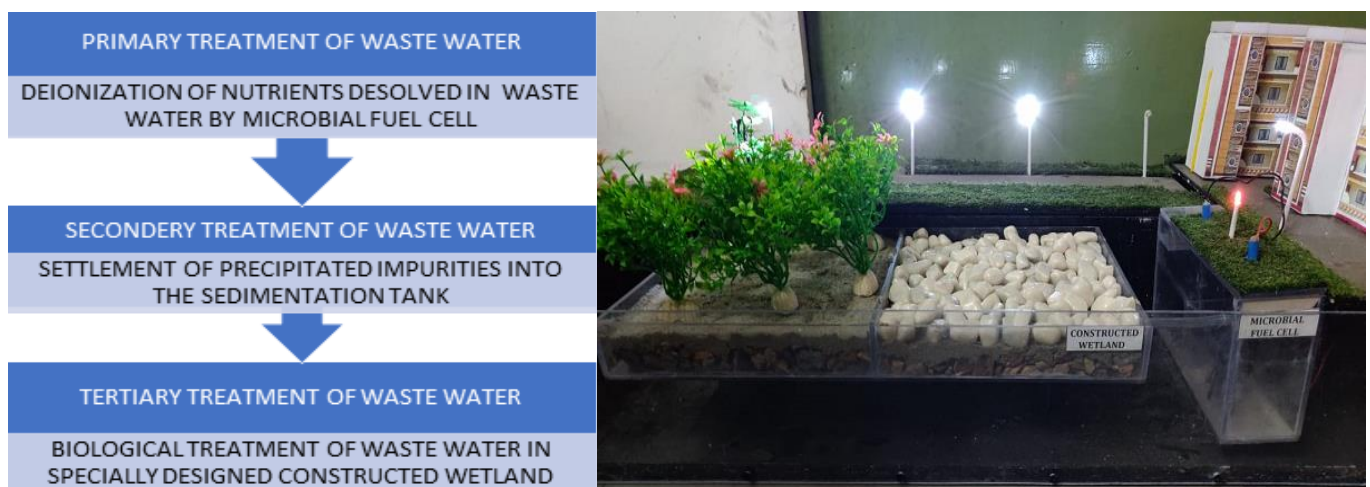
3. Methods

The methodology of process involves the simple collection of daily waste water Okhla, Delhi and domestic waste water from ABESIT, Ghaziabad in bottles. The samples are then taken for physiochemical and biochemical analysis. Physiochemical parameters are then analyzed for waste water includes pH, BOD, COD, TDS, Conductivity, Turbidity, Oil and grease.

Tested waste water is then passed to the Microbial Fuel cell Set-up. In first stage the microbial fuel cell with the help of ion exchange process precipitated the impurities and settled down in the sedimentation tank.

In second stage the remaining waste water drained to the constructed wetland and will act as nutrients for the plants. The water will be treated by the six biological reactions involved in the performance of constructed wetlands, including Photosynthesis, Respiration, Fermentation, Nitrification, Denitrification and Microbial phosphorus removal. The treated water by this whole process will be pure enough to drain it directly into any water body or can be reused for various purposes.

We are developing combination of both the techniques so that we can reduce down the area required for the constructed wetland and nutrient recovery process.



4. Outcomes:

Waste Water Treatment is one of the biggest need of urban society and to address this problem we have initiated this project.

As far as outcome of the project is concerned, it will provide –

- Perfect combination of MFC + Constructed wetland + Renewable Energy Resource (Preferably Solar PV)
- An Ideal Technology to install in RWAs and Colonies.
- An alternative method which can be scaled up further for commercialization.

5. Scope

During 2015, the estimated sewage generation in the country was 61754 MLD as against the developed sewage treatment capacity of 22963 MLD. Because of the hiatus in sewage treatment capacity, about 38791 MLD of untreated sewage (62% of the total sewage) is discharged directly into nearby water bodies such as rivers and oceans which is causing following issues –

- A. Ground water pollution
- B. Threat to Aquatic life & Endangered species
- C. Eutrophication
- D. Bioaccumulation of Toxins and Heavy metals

Installation of proposed system, in communities to treat waste water generated in individual Resident Welfare Associations (RWAs), Colonies, Industries to enhance individual capacities to treat waste water and in next 5 years, if the system get promoted and commercialized, it can treat additional 20000 MLD waste water per day at generation spot itself.

6. CONCLUSIONS

- There are 35 metropolitan cities (more than 10 Lac Population), 15,644 Million litre per day (MLD) of sewage is generated from these metropolitan cities. The treatment capacity exists for 8040 MLD i.e. 51% is treatment capacity is created.
- Among the Metropolitan cities, Delhi has the maximum treatment capacity that is 2330 MLD (30% of the total treatment capacity of metropolitan cities)
- Next to Delhi, Mumbai has the capacity of 2130 MLD, which is 26% of total capacity in metropolitan cities.
- Delhi and Mumbai therefore in combination have 55% of treatment capacity of the metropolitan cities.
- Some cities such as Hyderabad, Vadodara, Chennai and Ludhiana and Ahmedabad treatment capacity meets the volume of generation.
- Cities like Delhi, Dhanbad have more than 50% capacity, rest of the cities have the capacity less than 50%

Further development and Commercialization of our proposed system can improve the above said situation of waste water treatment and nutrient recovery.

REFERENCES

- 1) Bruce logan research-microbial fuel cell
- 2) Microbial fuel cells: recent developments in design and materials by G Bhargavi
- 3) Microbial fuel cell: a green approach for the utilization of waste for the generation of bioelectricity by V Chaturvedi-2016

- 4) Constructed wetlands as a sustainable waste water treatment method in communities by Z ElZein-2016
- 5) Constructed wetland: a review: international journal of environmental studies by Miklas Scholz published on 26 Jan 2007
- 6) Sajithkumar, K.J.; Ramasamy, E.V. Greywater treatment with simultaneous generation of energy using low-cost microbial fuel cells. Environ. Res. Eng. Manag. 2015